

# Centre for Appropriate Technology

“Renewable energy in outback Australia”

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# Renewable Energy in Outback Australia

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This paper examines the characteristics of a substantial market entry point for renewable energy (RE), in particular RAPS. It acknowledges the dedicated work of researchers and industry who spend incredible amounts of energy perfecting components, processes and systems that enable society to harness renewable energy resources. It might reasonably be expected that the effort of the past decade would have provided greater market penetration than appears to be the case. The paper focuses on the socio economic and cultural environment that embraces the technical advances that science provides and suggests other factors which will assist the delivery of renewable energy to the outback of Australia and to the remote villages and communities of the world.

## ***Taking Stock of Where We Are***

Stephen Hill, the Regional Director of UNESCO, recently argued there was a crisis of trust between science and society which needed to be addressed if we were to successfully enter "the new order of science".<sup>1</sup> He spoke of a new human contract between science and society.

"The current contract between science and society is confused. Science-in-service-of-business is racing ahead of a confused, largely ignorant and disempowered society and dragging it along behind the technical and market oriented dictates of the closed worlds of the laboratory and ..... the corporate boardroom."<sup>2</sup>

His paper challenged scientists to reestablish a more satisfactory contract which placed people more centrally into the process of prioritising choices of where scientific enquiry should focus.

In considering how to present a review of renewable energy in the outback of Australia, Hill's reference to the Millennium Bug has stimulated a more critical than promotional response to the assumptions and stereotypes that are often discussed in the context of the potential of RE in the outback..

“The Millennium Bug is a timely reminder of the need for guarding against the hubris of unblinking faith in the assumptions of technical expertise that are made within specialised domains but which impact at the deepest level on our social world.”<sup>3</sup>

There is a sense that we are at a cross road in the field of renewable energy. Over the last couple of years the debate surrounding Renewable Energy (RE) has shifted from an early fascination with the science of converting solar and wind energy into electricity and refocussed on reduction of greenhouse emissions and our national obligation to contribute to global reduction of emissions. This shift no doubt reflects concern for what is predominantly an urban problem and a perceived lack of progress with the early market opportunities pursued through RAPS. Under the old order the pursuit of efficient PV cells and electronic wizardry for power supply had reasonable support, however, there is a sense that this emphasis on developing new energy generation sources has been supplanted by a more convenient option of making non-renewable energy sources more efficient. No doubt this shift also derives from a new economic imperative to eliminate long lead times and commercialise research as soon as possible.

In reviewing the performance of renewables and their contribution to development of villages and communities in the third world and Australia Prime Power Systems of WA reflected on three decades of attempting to put the rhetoric into practice.

“The use of renewable energy-based electric power systems has been promoted through hundreds of demonstration projects and the investment of many millions of dollars. Yet today it is difficult to find many examples of successful rural electrification projects.

So what has been going wrong in the recent application of renewable energy technology? For a start the consumer is often accused of expecting too much for too little. Suppliers of equipment are suspected of pushing immature products into the field and then not backing them up professionally. The owner and planner are blamed for focussing on cost, not value, on capacity, not services and generally ignoring the requirements for sustainability. The financier is considered intransigent and demanding of excessive terms with little or no risk.

Unless this cycle is broken the future of large scale rural electrification using renewable energy is problematic at best”.<sup>4</sup>

All is not lost, however. The National Renewable Energy Laboratory reports numbers of systems operating in South East Asia, West Africa, North America, Nepal and South Africa, some since 1982..<sup>5</sup>

It has long been thought that the economics of using renewable energy options in Australia may be most advantageous in remote areas which have traditionally been expensive to supply with electrical energy. It is a truism that if renewable energy can be applied in remote areas they (remote settlements) will be more sustainable and easier to live in. These remote outback communities have high diesel fuel costs and abundant solar insolation, so it is often quite easy to make a compelling technical and social argument on their behalf to support research leading to improved system efficiencies, to pursue cheaper PV panel costs and make renewable energy more competitive in outback Australia.

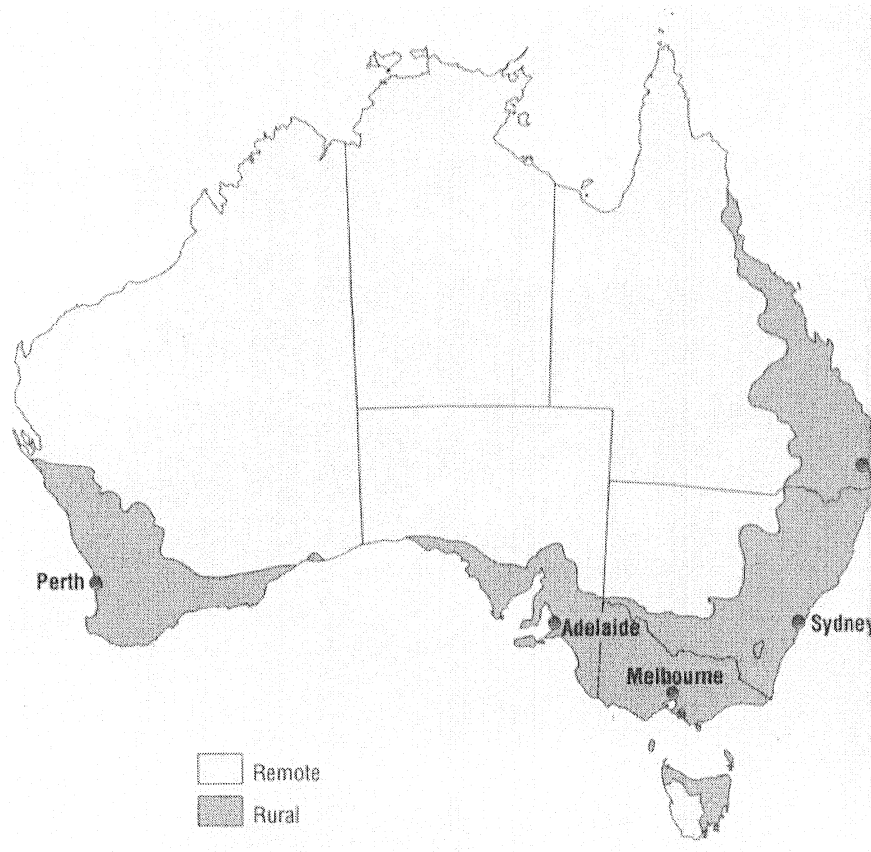
Given these logical arguments it is no doubt surprising that the outback of Australia is not liberally endowed with successful renewable energy systems.

The Centre for Appropriate Technology (CAT) <sup>6</sup> in Alice Springs has been undertaking an extensive review of Renewable Energy in Remote Communities as part of a commitment to the research effort of the Australian Centre for Renewable Energy (ACRE). It has also conducted a significant study and trial of hot water systems in remote communities in South Australia, Northern Territory and Queensland for the Aboriginal and Torres Strait Islander Commission (ATSIC). Both of these studies are reported separately at this conference and they provide some useful insights on how RE options might be recast to meet human demands in the outback.

### ***The Australian Outback***

For the benefit of overseas visitors and those who rarely proceed beyond the 100 km coastal limit in Australia, the outback is where you find the spirit of Australia.

It is a term which conjures up images of a colonial past, of a rough tough frontier comprised of pastoral properities and mining towns, where Indigenous people weave their way in and out of life. The term remote community is often used to describe the settlements dotted throughout this vast area of Australia, although this is generally used as a euphemism for communities of Indigenous people. This paper argues it is necessary to gain a clearer insight into the people and circumstances of the outback in order to better understand the challenge of introducing RE technology.



Australia's population is highly urbanised. In 1991, 85 per cent of Australians lived in settlements with populations of 10,000 or more. The remaining 15 per cent live in small country towns on farms or in remote settlements. Australia's largest settlements occupy less than one per cent of the nation's land area.<sup>7</sup>

The map illustrates the unique distribution of Australians with almost 94 per cent of the Australian population living within 100 kilometres of the Australian coastline.

The following table indicates the size of the great outback, an area largely comprising what is known as rural and remote Australia.

<b>Proportion of Australians living in urban rural and remote settlements, 1991,</b>		
	<b>Number</b>	<b>Percentage %</b>
<b>Urban</b>		
Big Cities (above 1 million)	10,062,003	59.7
Other Cities (80 000 to 1 million)	2,025,803	12.0
<b>Rural</b>		
Large Rural Towns (25 000 to 80 000)	962,041	5.7
Small Rural Towns (10 000 to 25 000)	853,051	5.1
Rural Other (less than 10 000)	2,452,264	14.6
<b>Remote</b>		
Remote Towns (above 5 000)	203,137	1.2
Indigenous Settlements	73,297	0.4
Remote Other	209,973	1.2
<b>TOTAL</b>	<b>16,841,569</b>	<b>100.0</b>

Source: Commonwealth of Australia, *Australia: State of the Environment*, p3-4

### **Rural Areas**

Rural Australia (defined as the cropped or cultivated zone) covers a wide range of climatic and land use areas reaching as far inland as receives sufficient rainfall to support agricultural activities. While the larger rural areas are maintaining their populations the drier wheat/sheep belt is undergoing population decline. This population decline on the land and in the small rural towns undermines the economic viability and livability of the towns. In such circumstances there is rarely the capital and security to invest in new renewable energy options unless they offer an immediate and provable economic return.

### **Remote Settlements**

Although only a small proportion of Australia's population lives in remote settlements, they service vast areas of the continent and are a significant part of what defines Australia's outback. Remote-area land use patterns are

diverse, ranging from pastoralism, tourism, mining and indigenous communities. Remote settlements demonstrate a high degree of functional diversity relative to their size, acting as foci for their service regions and links to services outside the region.

Remote area land use is being restructured and rationalised as commodity prices fluctuate and as people move to larger cities in search of enhanced levels of service provision.

The effects of climatic variation and deterioration of pasture quality have contributed to a decline in the number of cattle and sheep in the pastoral industry. Lower stock numbers tend to make the pastoral industry less financially viable which affects economic and social infrastructure in remote areas. Pastoralists are very pragmatic and often cannot afford to keep pace with new technology unless it is well proven.

Remote settlements receive a much lower proportion of tourists than urban areas but the tourists generally have high standards and expectations of service delivery and have a significant impact on local economies and their energy requirements.

Resource extraction has given rise to the establishment of many mining settlements in the outback although the trend is now for workers to fly in and fly out, thus directing more wealth and development to the coastal cities rather than back into the outback. This shift creates lower levels of service and reduced livability in the outback. Mine sites generally have high energy demands and apart from communications and remote monitoring applications they are largely not concerned with RE applications.

In summary, there are compelling technical, climatic and economic arguments to enhance the uptake of RE in these areas. The socio-economic forces and the apparent general decline of rural services points to a very conservative market once the tourist and mining interests are excised.

It is instructive to compare the resource inputs between the mining town of Yandicoogena and a remote Indigenous settlement on a per capita basis.

Selected per capita resource flows in four different sized settlements, 1990				
	Sydney pop. 3,656,500	Warrnambool pop. 24,720	Indigenous community pop. 300-400	Yandicoogina pop. 79-159
<b>Resource inputs (per head)</b>				
Water (tonnes)	180	182	241	946
Food (tonnes)	1	1	1.07	0.74
Energy (MJ)	115,377	102,997	29,000	177,630
<b>Waste outputs (per head)</b>				
Solid waste (tonnes)	0.77	0.94	0.2	1.58
Sewage (tonnes)	128	104	n/a	n/a

Source: Commonwealth of Australia, *Australia: State of the Environment*, p3-35

Remoteness itself increases risk in a number of areas. For example, rural and remote settlements have higher mortality rates for coronary heart disease and stroke. While there may be medical reasons for this, the time and distance involved in responding to onset of symptoms is no doubt a factor.

A comparison of some other health indicators provides a better appreciation of the difference in service levels between urban and outback Australia.



Injury and Poisoning: and Respiratory Diseases: Standardised Mortality ratios by settlement type, 1990-1992				
Cause of death	Metropolitan	Other cities	Rural	Remote
<b>Injury and poisoning</b> (ICD9 E800-E999)	0.9	1.02	1.17	2.06
Motor vehicle accidents	0.84	0.98	1.35	2.15
Accidental drowning	0.81	1.41	1.21	2.26
Suicide	0.96	1.06	1.07	1.29
Homicide	0.92	0.88	0.85	4.53
Production injuries	0.73	0.95	1.65	2.38
<b>Respiratory diseases</b> (460-519)	0.97	0.96	1.04	2.26
Pneumonia, influenza and bronchitis	0.95	0.98	1.05	2.45
Asthma	0.96	0.85	1.16	1.05

Source: Commonwealth of Australia, *Australia: State of the Environment*, p3-30

### Indigenous Communities

The number of remote Indigenous communities has grown over the last 20 years largely due to the outstation movement which began in the early 1970's. In 1992 ATSIC identified almost 1385 indigenous communities throughout Australia - 819 of which were in remote regions.

From a total Indigenous population in 1992 of 265,378, sixty five per cent lived in rural and remote areas. Indigenous people represented almost 20 per cent of the remote population at that time.

<b>Indigenous Communities in Remote Australia</b> (Only includes discrete communities of Indigenous people.)			
	Number of Communities	Population of Communities	Average Size of Communities
NSW	37	4203	114
SA	88	3861	44
QLD	82	16672	203
WA	182	18602	102
NT	430	29959	70
Total	819	73297	Av. 106

Source: Commonwealth of Australia, *Australia: State of the Environment*, p3-16

The 1992 ATSIIC survey identified 819 discrete Indigenous communities with an average size of 106 people with a range from 10 to over 2000 people. Some of these communities can pay between eighty to one hundred thousand dollars per year for diesel fuel.

A more recent study by CAT<sup>8</sup> reveals the break-up of indigenous population by the size of the community. (Figures in this table vary from those stated earlier because they were compiled for a different purpose using a different definitional position). Never the less they provide an indication of the small groupings of people across remote Australia.

	<b>Number of remote communities in population range</b>						Total
	Small		Medium		Large		
People in Community	0 to 20	21 to 50	51 to 100	101 to 200	201 to 500	over 500	
Total No of Communities	662	244	68	57	65	26	1122
Total Population	5776	7922	4944	8532	21198	27769	76141
Percentage of Population	8%	10%	6%	11%	28%	36%	100%

Source: Centre for Appropriate Technology, 1998

Provision of services is extremely challenging in communities with small populations and high levels of mobility. These factors combined with a lack of access to specialised services, low levels of technical training, and small community budgets, all work to impede technology transfer. Whilst it may be possible to improve economies of scale through a regional response in general circumstances are less than ideal for launching new technological initiatives.

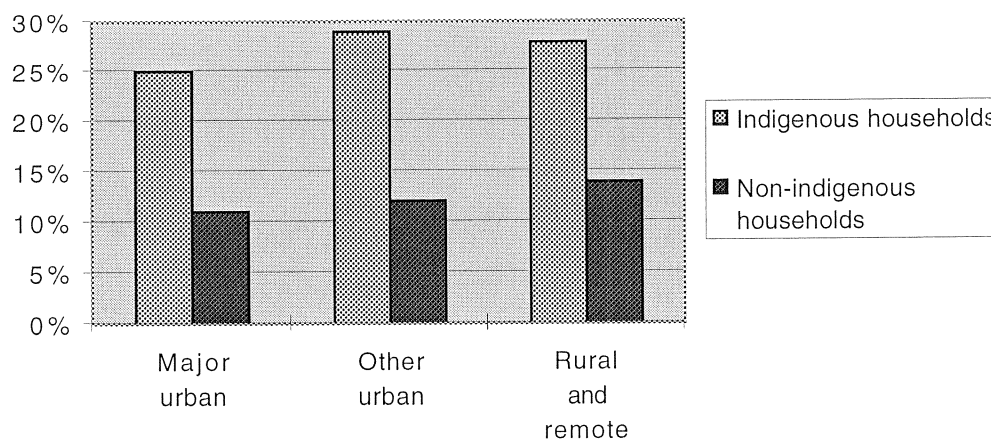
A national ABS survey <sup>9</sup>in 1994 showed the unemployment rate for indigenous people was 38% compared with 9% of all Australians, 69 per cent of indigenous households lived in rented premises compared with 27 per

cent of all Australians. Twenty nine per cent of indigenous people worried or sometimes worried about going without food. The expectation of life is 16 - 20 years less than that for the total population.<sup>10</sup>

Pholeros<sup>11</sup> found considerable movement between houses by families in one community. In a community with twelve houses, three family groups accessed three houses each, five family groups accessed two houses each and one family had been in five houses over a thirteen month period. Only two family groups enjoyed uninterrupted occupancy. Under these circumstances the notion of user pays is problematic. Another report<sup>12</sup> found one third of houses in one community had power disconnected due to unpaid accounts.

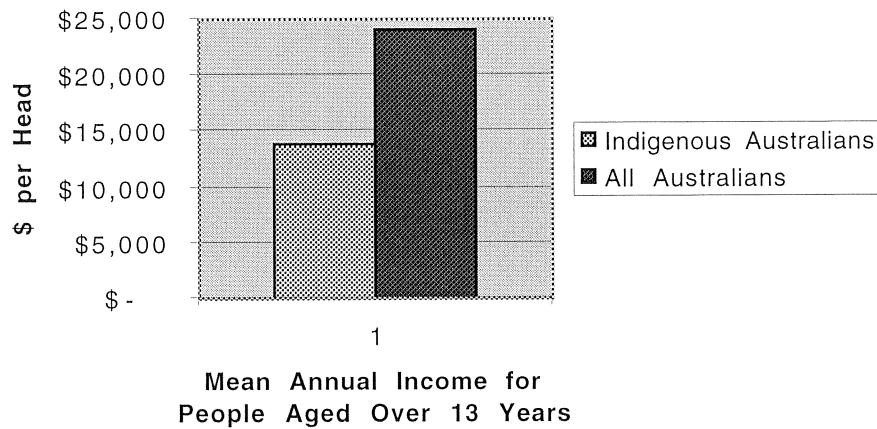
After housing poverty is significantly greater for Indigenous people therefore their ability to access specialised appliances necessary for enhancing energy efficiency in the home is severely curtailed.

### After-Housing Poverty



Source: Commonwealth of Australia, *Australia: State of the Environment*, p3-25

## Income Inequality and Race



Source: Commonwealth of Australia, *Australia: State of the Environment*, p3-19

Indigenous people are on average about \$10,000 per person worse off in their mean annual income than all Australians.

This brief exposure to a range of indicators for indigenous and non-indigenous people living in the outback highlights the importance of obtaining a better understanding of the profile of needs that renewable energy options might be expected to meet.

In this context it is not difficult to come to the conclusion that the issues to contend with in developing renewable energy systems in the outback are not purely technical or at least that the technical issues are minuscule compared to the complex of socio economic issues.

### ***The Renewable Energy Industry***

It is not only the social and demographic characteristics of the people of the outback which make the development of RE difficult.

There are significant concerns with the messages that the RE industry and research community send to people in the outback.

Those with an interest and philosophical attachment to RE have promoted an image built on leading edge research into renewable generation breakthroughs. RE researchers are portrayed striving for efficiency in output, pursuing the perfect battery, developing revolutionary solar electric vehicles and selling the message that renewable energy is free, clean and green.

Renewable Energy technology is showcased through demonstrations of research excellence and solar car races. There is, however, very little public education in relation to the lifestyle tradeoffs necessary in using RE.

Consider the following short video clip. The first is an advertisement currently being aired on television in outback Australia. The second is a news clip.

Show overheads of people watching TV outside.

### ***What Do People In The Outback Make of This?***

CAT's research into attitudes towards RE in the outback has shown that people are not necessarily turned on by a 2 per cent improvement in cell efficiency. Poor initial experiences and high capital costs have affected many pastoralists views and the views of those who provide finance such as ATSIC.

Of the 90 systems surveyed across pastoral, tourist and indigenous sites in the NT and SA most users are relatively unconcerned with the environmental benefits of pursuing renewable options. Only 11 per cent of those surveyed thought energy conservation was important and 9 per cent thought environmental issues were important.

Aboriginal people in particular become slightly agitated when they realise that renewable energy is not free as advertised, but there are ongoing costs that are involved. Battery maintenance is either non existent or erratic. Only 32 per cent of systems were under a maintenance contract. For many pastoralists it is often cheaper to upgrade the diesel component rather than replace the batteries of a hybrid system.

Robust pragmatists like pastoralists look at the images of RE like solar cars and rapidly conclude that RE systems are all lightweight, flimsy things that wouldn't last out bush. (A notable exception is solar powered water pumping which has finally found acceptance through an excellent match between technology and need). There is a need for the RE industry to produce standardised, reliable, robust user friendly designs that can't be vandalised or pilfered.

Communications in the bush are still largely by word of mouth and comparative experience. Success on a neighbouring property is the best marketing tool. It is not uncommon for people to be able to tell you all of the failed systems but have difficulty recalling the successes. In CAT's survey 62 per cent of respondents claimed they had recent problems with their systems, while 39 per cent experienced recurrent problems. A most surprising aspect is that only 8 per cent were trained in the care of the system.

So while the public imaging of RE might provide a buzz for the technology buffs, the environmentalists and enthusiasts who live in the coastal fringe, the current imaging would appear to do inestimable damage to perceptions in the outback. Under these circumstances it could well be asked who it is that needs education in relation to the acceptance and transfer of renewable energy technologies.

Transport costs generally dominate capital and maintenance costs in the outback. Consequently reliability is always more important than efficiency in keeping a system operational. Successful systems are linked with regular maintenance contracts. The RE research and development agenda is on the other hand still largely driven by price and efficiency and environmental gain. This is reflected in industry marketing of RE systems. Publicity generally outlines efficiency of components, however, there is little information on reliability of components or availability of service networks in promotional material. The research in the outback indicates that the most significant single factor in the minds of the end user is reliability of the total system.

In relation to indigenous communities people just want to be warm or cool, to cook and see in the dark, they want water and hot water to wash and drink, they want to communicate, play in the band and watch television. Basically they want to live with the highest level of service that can be provided and afforded. In as much as these things involve energy or electric power one could say they are wanted, however, people are generally not wanting to buy an energy system or own an electric utility. They want to buy a reliable service and obtain a benefit. Their expectations of the benefits will change over time and as development occurs. Indigenous communities generally place a higher priority on function than on the fact that a system uses renewable energy. Overloading of systems is therefore common due to high household size fluctuations and high expectation of systems once installed. To date the RE industry has tried to constrain demand to match the economics of the technology. Responsive flexible systems will be required in the future. Currently the risk of overload is met through installation of diesel backup and system oversizing.

As an industry and research community we need to do better than this if we are to convince the people of the outback that RE is viable and reliable.

### ***Are Other Analogies Helpful?***

If we use the analogy of the car it may make it easier to understand the dilemma faced by the RE industry.

When a consumer purchases a car they identify a brand which they wish to purchase, test drive it to see if it meets their requirements and then purchase

the total package. The car company shoulders the responsibility for bringing together the components to form the car and the marketing of the final product. They become a single point for service, advice, repair, trade in and update and for market research and they establish the framework for technological advances. It is rare to find the manufacturer of the fuel injection system or the engine components advertising their component or promoting research of new materials.

The promotion of cars is driven by human needs and expectations. A state of the art braking system is promoted not because it is technologically smart but because it appeals to the drivers sense of security and safety. Car manufacturers have franchises across the country even in outback Australia. Quality control, interchangeability of parts, training, regular service outlets and maintenance schedules. These are things that are largely not yet thought about in relation to RE.

The RE industry which has so many complex components to assemble and important research advances to make, has no recognisable face or brand to provide users with a measure of confidence in the total product. We invest this task in the many small RE suppliers, electrical contractors and engineering consultancies around the country as they piece together workable systems.

### ***Is There A Future For Renewable Energy In The Outback***

In short there are two key principles for successful application of renewable energy in outback Australia.

- People will use a service (technology) that allows them to very simply and cheaply derive a benefit.
- The provider of the service (technology) and the consequent benefit must be reliable above all else.

The intention of this paper has not been to demoralise members of the RE industry. It is clear that the task is huge and the potential rewards are great if we have the clear sight to take action now. It is difficult to see a viable national industry emerging if the current division of labour, knowledge, resources and capital is not addressed. Perhaps the best way to establish this would be to ask how or who in Australia could successfully tender for a \$30 million dollar World Bank Rural Electrification Project. It could be argued that on the basis of our experience in the Australian outback we do not know enough about the characteristics of small rural/remote villages and communities to enable a renewable energy option to be sustained.

There is a clear need for a paradigm shift away from an emphasis on the development of RE technology to the provision of services that meet the needs of people in the outback. Perhaps this will occur through an evolutionary process as there are already some signs of change. Bannister<sup>13</sup> explores various forms of performance contracting as a method of managing the risks involved in a changed service delivery paradigm. Jennings and Healey<sup>14</sup> outline some of the key decisions necessary to ensure the success of RE in the outback although they stop short of recommending a structural change to emphasise service and benefits using RE.

It is clear that an RE industry which pursues sales to the exclusion of services faces a very short life and further loss of trust from the population in general. This approach only exacerbates the crisis of trust which Hill alerts us to. Individual suppliers and researchers cannot afford to have their own investments placed at risk because of another suppliers premature entry into the market place raising expectations with products that fail or leave a bad name for the industry.

While RE could penetrate the local Australian market for energy supply it does so more as a contribution to greenhouse gas abatement than as an energy substitute at the present time. The real markets economically are unlikely to be in Australia. Therefore the sooner an Australian Brand/Reputation develops so that it is recognised for its sustained success, the sooner all members of the research community and industry will achieve the goal of building a sustainable RE industry in Australia and the people of outback Australia will be well served.

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<sup>1</sup> Stephen Hill, *Science and Society: A New Human Contract for the Millennium*, UNESCO Asia Pacific Conference - Science Issues for the 21st Century, University of NSW, Sydney, December 1998.

<sup>2</sup> Ibid, p3

<sup>3</sup> Stephen Hill, *Science and Society: A New Human Contract for the Millennium*, UNESCO Asia Pacific Conference - Science Issues for the 21st Century, University of NSW, Sydney, December 1998.

<sup>4</sup> Prime Power Systems Pty Ltd, *Rural Electrification: A Decade of Lessons Learned in the Area of Community Power System Design*. Company Report, Pers.Comm 1996, Advanced Energy Systems, Bentley, WA

<sup>5</sup> Village Power Profiles for the NREL RSVP Village Power Data Base,

<sup>6</sup> **The Centre for Appropriate Technology, Alice Springs, Northern Territory (CAT)** is an Aboriginal and Torres Strait Islander controlled association whose primary aim is to research, design, develop, produce and teach technologies appropriate to remote communities. CAT has a national focus and seeks to improve access to information on appropriate technical services and options for Indigenous people living in remote communities. CAT's Clearinghouse provides a national focal point for Indigenous communities seeking information about appropriate technology. Its strategy has a central focus on Indigenous community housing and infrastructure issues. Information and advice from the Clearinghouse, assists informed decision-making by remote communities, and strengthens capacity for self-determination. Within the broad field of 'appropriate technology' CAT maintains *competencies* to provide services in the following *thematic* areas: Water Supply and Sanitation, Shelter, Waste Disposal, Energy, Transport, Communications, and Natural Resource Management.

<sup>7</sup> Commonwealth of Australia, *Australia: State of the Environment 1996*, CSIRO Publishing, 1996